Today's Presenters

Justin Cherny, PhD
@JoVEJournal
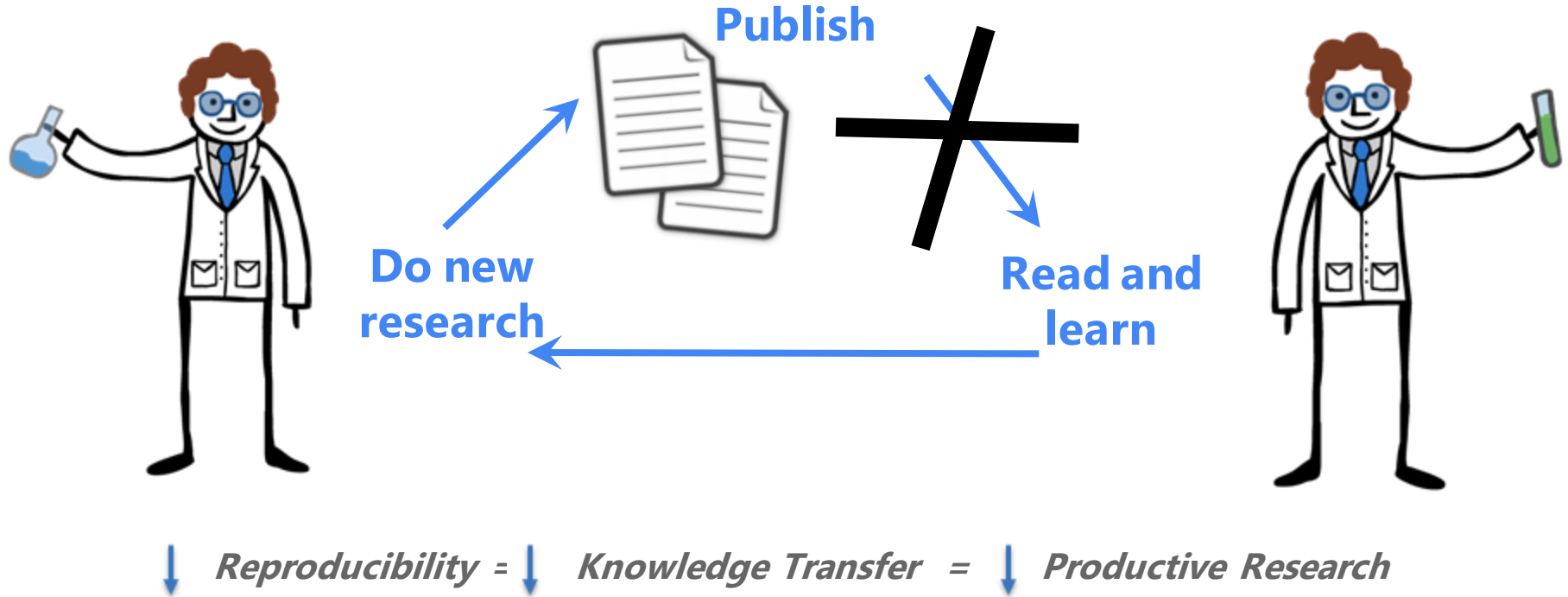VP of Operations
JoVE

Melissa Rethlefsen
@mlrethlefsen
Associate Dean
University of Florida

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Research Services Librarian
University of Toronto

Lack of Reproducibility Damages Science

Reproducibility is a Serious Problem
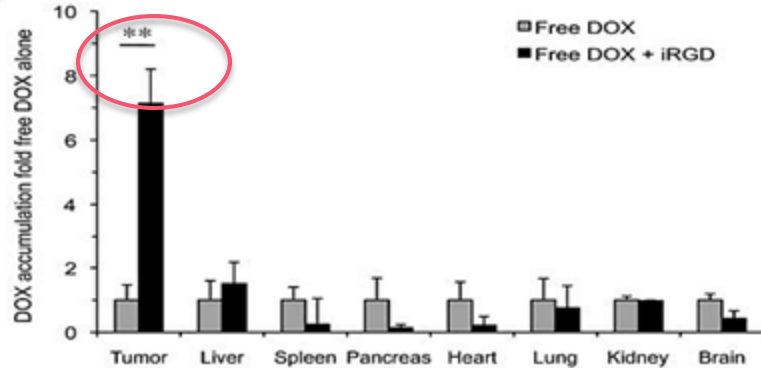
U.S. only NIH funding: ~$40 B/year

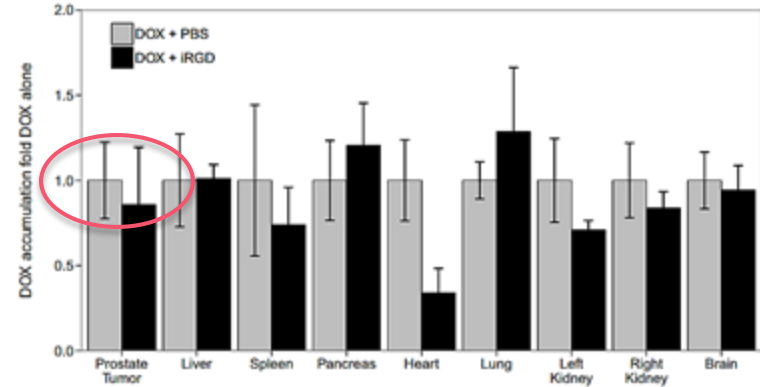60% to 90% not reproducible

Loss: $24-36 B/year

Impact:

➢ **For society**: delays in development of new medicines and low ROI

➢ **For institutions**: poor productivity

➢ **For scientists**: difficult careers

How do Scientists Deal with Reproducibility in the Lab? It is all about Methods

Sugahara et al. 2010 Science (Original Study)

Mantis et al. 2017 eLife (Cancer Reproducibility Project)

1. Repeat again and again until it works (at the expense of their institution)

2. Find someone at your institution who can **show** you how to do the experiment

3. Travel to see original authors who can **show** you how to do the experiment

# Why Showing an Experiment Improves Reproducibility

TEXT ARTICLE

Position the metaphase spindle at 3 o'clock and hold it with holding pipette. Apply piezo pulses to penetrate the zona pellucida. Touch the metaphase plate with the enucleation pipette. Aspirate the spindle and withdraw the pipette.

REAL LIFE

Visualization improves knowledge transfer of how-to (methods)

Reproducibility as a Responsibility
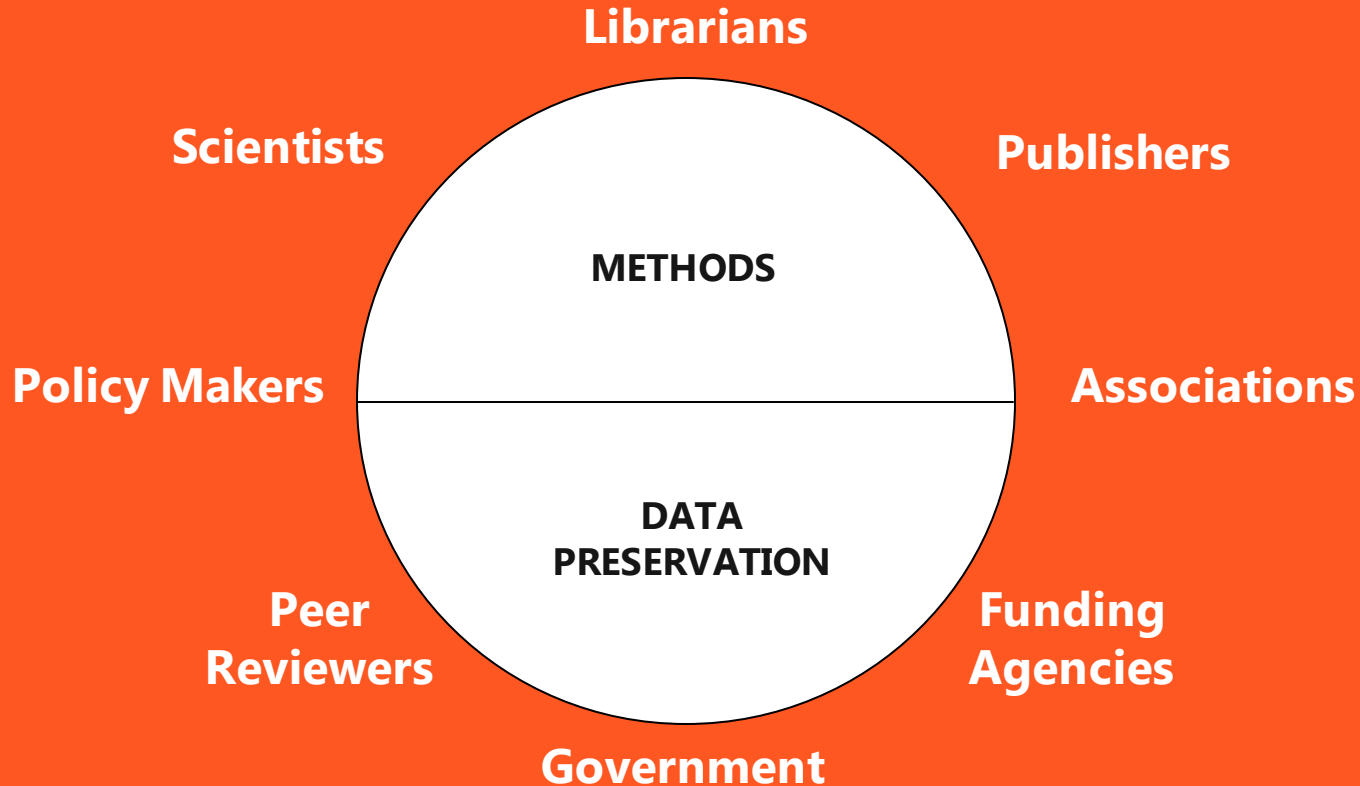
Librarians as Agents-of-Change to Solve to the Reproducibility Problem

Educate and drive change from everyone involved

- Educate your faculty, students and management about reproducibility and the solutions available

- Focus on solutions that increase reproducibility from your vendors

- Encourage your faculty to improve their publications to increase reproducibility

What do we mean by "reproducibility"?

Why librarians?

Why Most Published Research Findings Are False

John P. A. Ioannidis

Summary

There is increasing concern that most current published research findings are false. The probability that a research claim is true may depend on study power and bias, the number of other studies on the same question, and, importantly, the ratio of true to no relationships among the relationships probed in each scientific field. In this framework, a research finding is less likely to be true when the studies conducted in a field are smaller; when effect sizes are smaller; when there is a greater number and lesser preselection of tested relationships; where there is greater flexibility in designs, definitions, outcomes, and analytical modes; when there is greater financial and other

factors that influence this problem and some corollaries thereof.

Modeling the Framework for False Positive Findings

Several methodologists have pointed out [9–11] that the high rate of nonreplication (lack of confirmation) of research discoveries is a consequence of the convenient, yet ill-founded strategy of claiming conclusive research findings solely on the basis of a single study assessed by formal statistical significance, typically for a p-value less than 0.05. Research is not most appropriately represented and summarized by p-values, but, unfortunately, there is a widespread notion that medical research articles

is characteristic of the field and can vary a lot depending on whether the field targets highly likely relationships or searches for only one or a few true relationships among thousands and millions of hypotheses that may be postulated. Let us also consider, for computational simplicity, circumscribed fields where either there is only one true relationship (among many that can be hypothesized) or the power is similar to find any of the several existing true relationships. The pre-study probability of a relationship being true is $R/(R + 1)$. The probability of a study finding a true relationship reflects the power $1 - \beta$ (one minus the Type II error rate). The probability of claiming a relationship when none

Lies, Damned Lies, and Medical Science

Much of what medical researchers conclude in their studies is misleading, exaggerated, or flat-out wrong. So why are doctors—to a striking extent—still drawing upon misinformation in their everyday practice? Dr. John Ioannidis has spent his career challenging his peers by exposing their bad science.

Dutch Cell Culture Contamination Renders Six-decades Worth of Studies False

SCIENCE

Many Psychology Findings Not as Strong as Claimed, Study Says

By BENEDICT CAREY   AUG. 27, 2015

Problems with scientific research

How science goes wrong

Scientific research has changed the world. Now it needs to change itself

THE TRUTH WEARS OFF

Is there something wrong with the scientific method?

THE CHRONICLE OF HIGHER EDUCATION

NEWS   OPINION   DATA   ADVICE   JO

☰ SECTIONS   FEATURED: 10 Teaching Innovators   How Can We Save Our Students From Themselves?   The Daily Briefing   How to Be a Dean
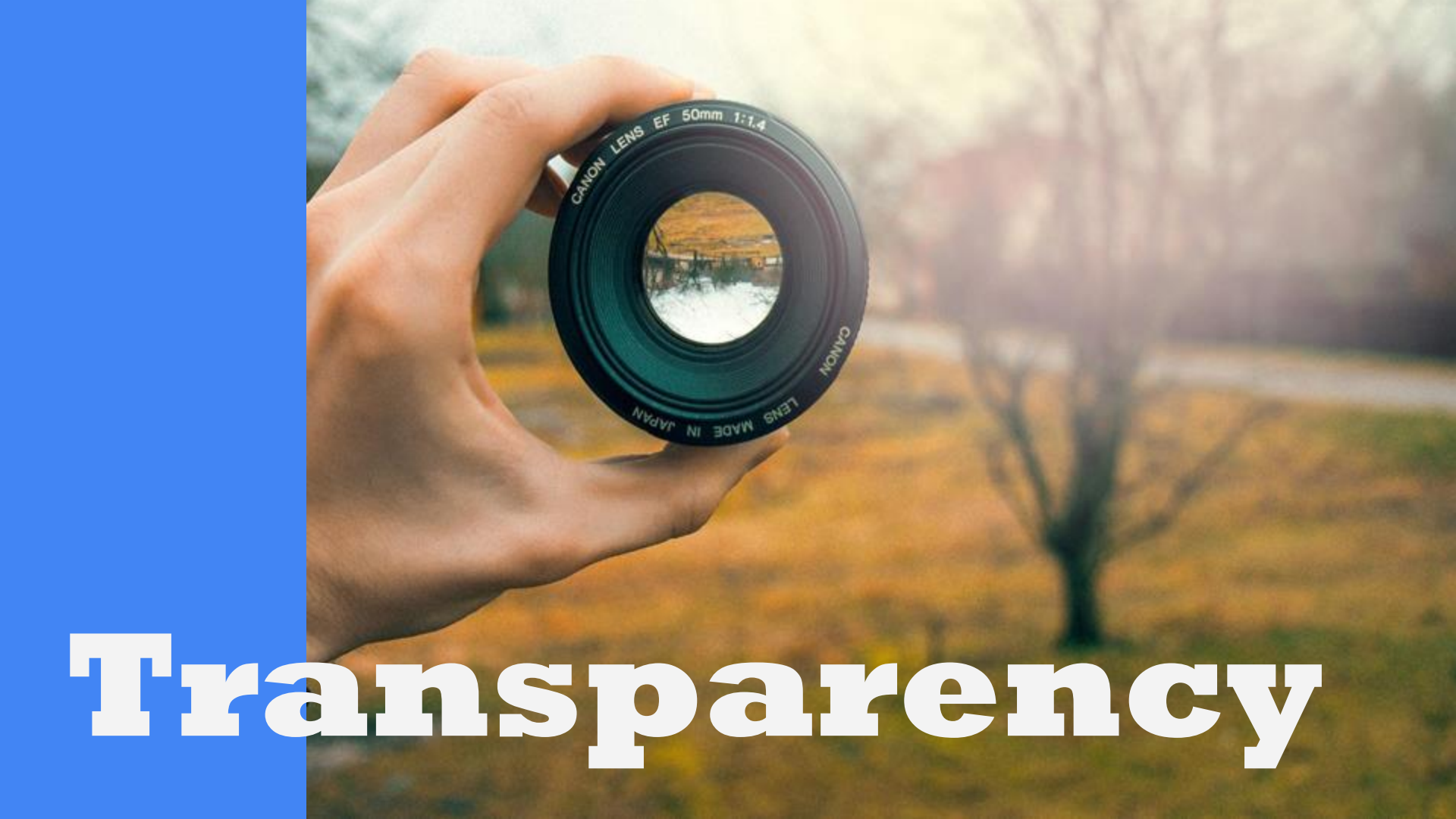
RESEARCH

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Amid a Sea of False Findings, the NIH Tries Reform

So Why Us? We're Good At:

Building Awareness

Education and Instruction

Providing Tools

Advocacy

Transparency

Workflow and documentation

- Vast majority of the scientific workflow obscured

- Hard to reproduce others work, hard to reproduce our own work

- Difficult to accumulate unpublished knowledge or use published results for additional analyses

In 2 years, will you remember every decision and choice made, how you made it, what tools and instruments you used/modified, and why?

Initiatives and guidance

equator network

Enhancing the QUAlity and Transparency Of health Research

Findable **A**ccessible **I**nteroperable **R**eusable

CASRAI

4 G's of authorship

No gifts   No guests

No ghosts   No guessing

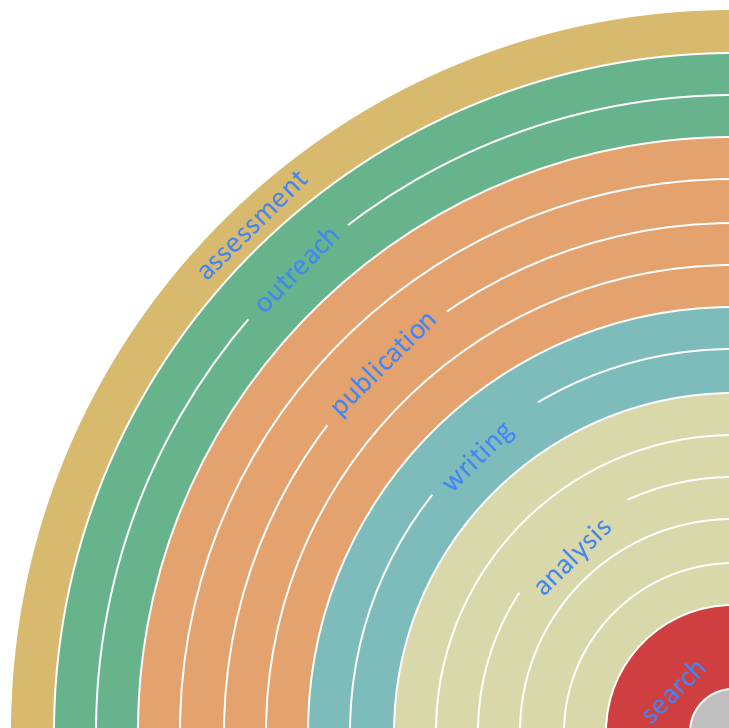**LEIDEN MANIFESTO FOR RESEARCH METRICS**

(TOP) GUIDELINES

CRediT

jove

BITSS Berkeley Initiative for Transparency in the Social Sciences

REWARD REduce research Waste And Reward Diligence

San Francisco DORA Declaration on Research Assessment

Some tools for transparency:

- adding alternative evaluation, e.g. with altmetrics
- communicating through social media, e.g. Twitter
- sharing posters & presentations, e.g. at FigShare
- using open licenses, e.g. CC0 or CC-BY
- publishing open access, 'green' or 'gold'
- using open peer review e.g. at Peerage of Science
- sharing preprints, e.g. at arXiv, bioRxiv or OSF
- using actionable formats, e.g. with Jupyter
- open XML-drafting e.g. at Overleaf or Authorea
- sharing protocols & workfl. e.g. at MyExperiment
- sharing notebooks e.g. at OpenNotebookScience
- sharing code e.g. at GitHub with GNU license
- sharing data, e.g. at Zenodo, Dryad, Dataverse
- pre-registering, e.g. at OSF or AsPredicted
- commenting openly, e.g. with Hypothes.is
- using shared reference libraries, e.g. with Zotero
- sharing (grant) proposals, e.g. at RIO

http://tinyurl.com/vienna-openscience
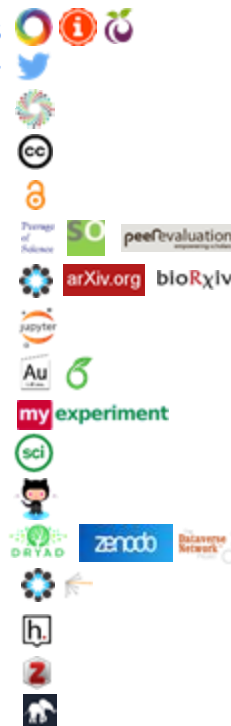
Start with your own actions

Open Science Framework

Badges to Acknowledge Open Practices

Name

Project: Badges to Acknowledge Open Practices

See the Impact

visits

Unique visits

Time of day of visits

Top referrers
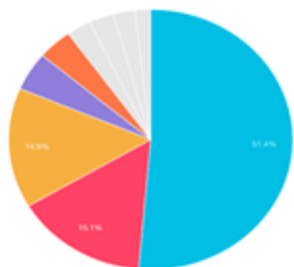
- osf.io
- direct link
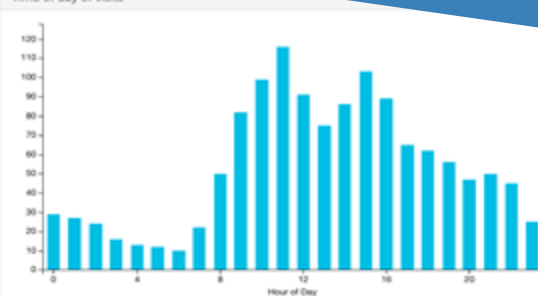- www.google.com
- www.amithson...
- cos.io

Popular pages

Forks

File: OSC2012.pdf

Registrations

	38.0 kB	114
	46.6 kB	130
	47.8 kB	173
	19. kB	11
	3.1 kB	94
	676.0 kB	57
	672.4 kB	54
	1.4 kB	74
	598.7 kB	55

File downloads

Links To This Project [1]

Linking to this project will reference it in another project, without creating a copy. The link will always point to the most up-to-date version.

View Links

Templated From [4]

This option will create a new project, using this project as a template. The new project will be structured in the same way, but contain no data.

Copy Project Structure

Forks [17]

Forks

Fork this project if you plan to build upon it in your own work. The new project will be an exact duplicate of this project's current state, with you as the only contributor.

Fork this Project

Barriers and incentives

Adopt, adapt, develop

Being transparent is a choice, we can all start making today

Action plan

Make a commitment to be transparent in your research practices by:

- Registering your protocols/projects/research plan
- Archiving your data in repositories
- Sharing your work via pre-prints/open access venues
- Adopting & contributing to open peer review
- Being transparent about team roles & research contributions
- Encouraging everyone, especially early career researchers, to get informed, and adopt these practices
- Training and advocacy
- Find the champions - better yet, become one!
- Don't quit

Reproducibility & Transparency are Transdisciplinary

Changing Academia is Hard

Transdisciplinary
+
Not Afraid of a Challenge
=

Librarians

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How Can We Create Institutional Change?

● Coalition Building

Research Administration

Epidemiology

Electrical Engineering

Philosophy

Psychology

Law

Computer Science
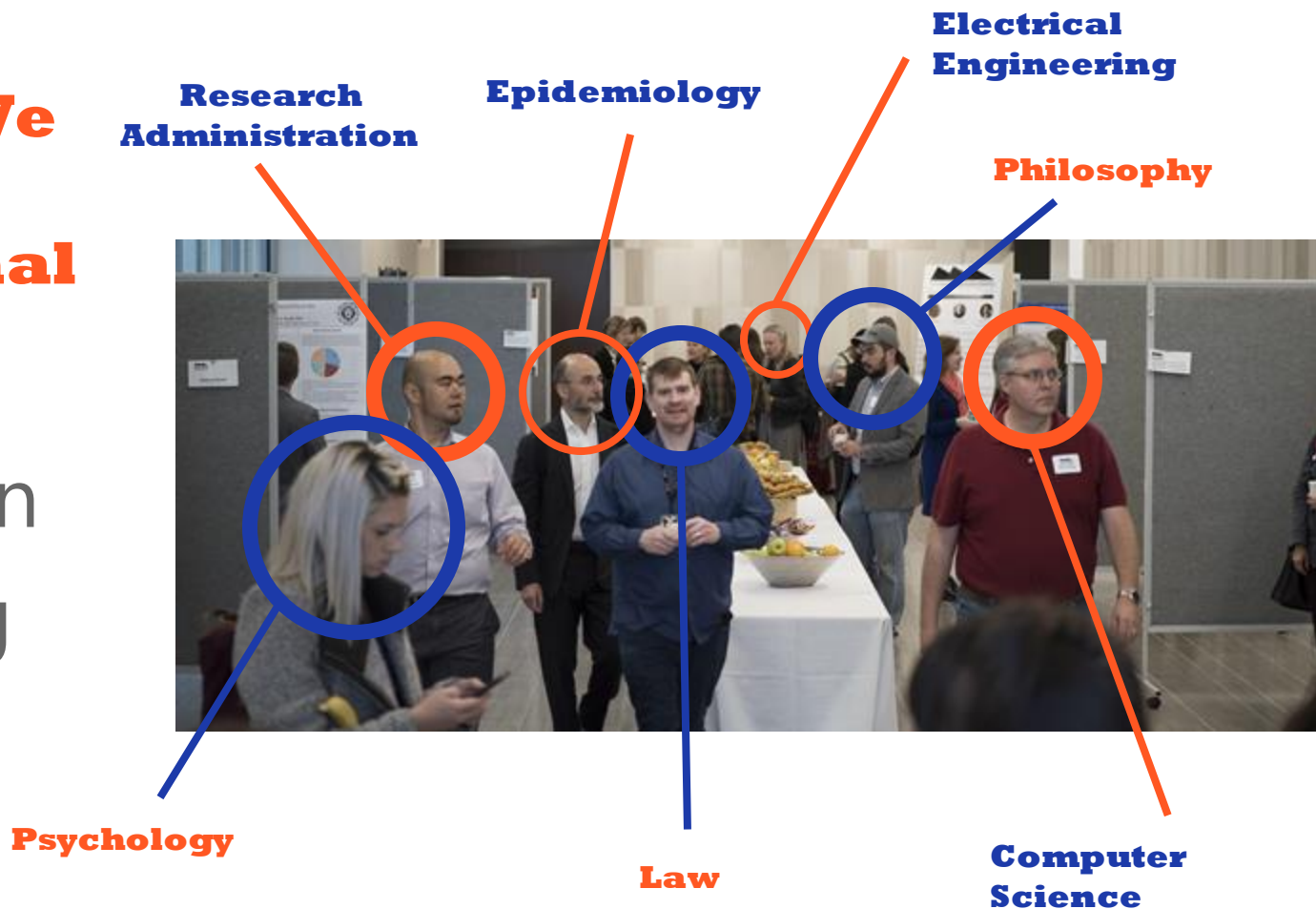
How Can We Create Institutional Change?

● Tools

- ● Electronic Lab Notebooks
- ● Preprint Servers
- ● Data and Artifact Repositories
- ● Institutional Versions of OSF, GitHub, etc.
- ● More...

How Can We Create Institutional Change?

● Advocacy & Education

Case Study:
University of Utah

#MakeResearchTrue

RESEARCH REPRODUCIBILITY
#MakeResearchTrue #UTAHRR 18

Department of Philosophy
THE UNIVERSITY OF UTAH

Research Reproducibility
November 14-15, 2016 | #UtahRR16
#MakeResearchTrue

GRAND
ROUNDS:
RESEARCH
REPRODUCIBILITY

**Research
Leadership
Lunch**

RESEARCH REPRODUCIBILITY: A YEAR IN REVIEW

381 subscribers

27 lectures

40+ coalition members

2713 video views

Will Change Happen Fast?

Not so much.

Perverse Incentives

Complexity

Not a Problem!

Policies & Laws

Money

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Takeaways

- Reproducibility is everyone's responsibility

- Be Johnny Cash - Walk the line

- BE RELENTLESS

- We are experts

- We can create change. Small actions count.

Resources

Rethlefsen ML, Lackey MJ, Zhao S. Building capacity to encourage research reproducibility and #MakeResearchTrue. *Journal of the Medical Library Association : JMLA*. 2018;106(1):113-119. doi:10.5195/jmla.2018.273.

Sayre, F., & Riegelman, A. (2018). The Reproducibility Crisis and Academic Libraries. *College & Research Libraries, 79*(1), 2. doi:https://doi.org/10.5860/crl.79.1.2

Ioannidis JPA (2014) How to Make More Published Research True. PLOS Medicine 11(10): e1001747. https://doi.org/10.1371/journal.pmed.1001747

Rethlefsen ML. 2017. Is research reproducibility a crisis? https://uofuhealth.utah.edu/coe-womens-health/cram/video.php?video=0_kiv4mk3q

Research Reproducibility 2018 http://campusguides.lib.utah.edu/UtahRR18/Conference

Resources

JoVE.com

Reproducibility blog articles: https://www.jove.com/blog/tag/reproducibility

Grand Rounds Research Reproducibility http://campusguides.lib.utah.edu/UtahRR18/GRRR

Reproducibility Resources LibGuide http://campusguides.lib.utah.edu/reproducibility/start

Research Reproducibility 2016 http://campusguides.lib.utah.edu/UtahRR16

Vienna Open Science Workshop. Open Science – What's in it for me? Practices and tools for your workflow. Available online at: http://tinyurl.com/vienna-openscience

Reproducible research practices.
https://mfr.osf.io/render?url=https://osf.io/u4q8m/?action=download%26mode=

Resources

What is OSF? https://osf.io/7mprv/

CRediT (Contributor Roles Taxonomy): http://docs.casrai.org/CRediT

EQUATOR Network http://www.equator-network.org/

Berkeley Initiative for Transparency in the Social Sciences (BITSS): https://www.bitss.org/

Open Science Training Handbook: https://doi.org/10.5281/zenodo.1212496

TOP Guidelines: https://cos.io/our-services/top-guidelines/

REWARD Alliance: http://rewardalliance.net/

DORA: https://sfdora.org/

Questions?